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(54) COPPER ALLOY SHEET EXCELLENT IN BENDABILITY

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a copper alloy sheet having excellent bendability while keeping the high strength of a Cu-Ni-Si alloy.

SOLUTION: This copper alloy sheet has a composition consisting of, by weight, 0.4-5% Ni, 0.1-1% Si, and the balance Cu with inevitable impurities and containing, if necessary, either or both of 0.01-10% Zn and 0.01-5% Sn. Further, when I{200}, I{311}, and I{220} represent the X-ray diffraction intensities from the {200} plane, {311} plane, and {220) plane at the sheet surface, respectively, inequality [I{200}+I {311}]/I{220}≥0.5 is satisfied.

LEGAL STATUS

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* NOTICES *

CLAIMS

[Claim(s)]

[Claim 1] nickel: The copper alloy board excellent in the bending nature characterized by filling the following formula when it consists of the remainder Cu and an unescapable impurity and X diffraction intensity from I {311} and {220} sides is further set [the X diffraction intensity from Si:{200} in board front face side] to I {220} for the X diffraction intensity from I {200} and {311} sides 0.4 - 5wt% including 0.1 - 1wt%.

[I{200}+I{311}]/I{220} >=0.5. [Claim 2] Zn:0.01 - 10wt% is included Si:0.1 - 1wt% nickel:0.4 - 5wt%. When it consists of the remainder Cu and an unescapable impurity and X diffraction intensity from I {311} and {220} sides is further set [the X diffraction intensity from the {200} sides in a board front face] to I {220} for the X diffraction intensity from I {200} and {311} sides, The copper alloy board excellent in the bending nature characterized by filling the following formula.

[I{200}+I{311}]/I{220} >=0.5. [Claim 3] Sn:0.01 - 5wt% is included Si:0.1 - 1wt% nickel:0.4 - 5wt%. When it consists of the remainder Cu and an unescapable impurity and X diffraction intensity from I {311} and {220} sides is further set [the X diffraction intensity from the {200} sides in a board front face] to I {220} for the X diffraction intensity from I {200} and {311} sides, The copper alloy board excellent in the bending nature characterized by filling the following formula.

[I{200}+I{311}]/I{220} >=0.5. [Claim 4] nickel: 0.4 - 5wt% and Si:0.1 - 1wt% and Zn:0.01 - 10wt%, It consists of the remainder Cu and an unescapable impurity including Sn:0.01 - 5wt%. The copper alloy board excellent in the bending nature characterized by filling the following formula when X diffraction intensity from I {311} and {220} sides is furthermore set [the X diffraction intensity from the {200} sides in a board front face] to I {220} for the X diffraction intensity from I {200} and {311} sides.

[I{200}+I{311}]/I{220} >=0.5. [Claim 5] B, C, P, S, calcium, V, Ga, germanium, Nb, Mo, Hf, Ta, Each element [of Bi and Pb] 0.0001 - 0.1wt%, Be, Mg, aluminum, Ti, Cr, Mn, Fe, Co, Zr, Ag, Cd, In, Sb, Te, one sort or two sorts or more of elements chosen from from while of each element [of Au] 0.001 - 1wt% -- the sum total -- less than [1wt%] -- the copper alloy board excellent in the bending nature indicated by either of the claims 1-4 characterized by containing

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[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the copper alloy board excellent in suitable bending nature to use for electronic parts, such as a copper alloy board especially a leadframe, a terminal, a connector, a switch, and a relay.
[0002]
[Description of the Prior Art] Various copper and the copper alloy are used for various electronic parts. In recent years, the flow of small-and-light-izing of electronic parts is progressing quickly. In connection with it, the outstanding bending nature which is equal to adhesion bending or 90-degree bending after notching is being required more often not to mention high intensity and high conductivity by the copper alloy board used for a leadframe, a terminal, a connector, a switch, a relay, etc. The Cu-nickel-Si system alloy is widely used for these uses especially as an alloy which has high intensity, high thermal resistance, a stress relaxation characteristic-proof [high], and comparatively high conductivity. However, coexistence of high intensity and bending nature was difficult for the present condition.
[0003]
[Problem(s) to be Solved by the Invention] Conventionally, the elongation in a tension test has been used as the standard as an index of bending nature. Depending for the value of the elongation to the rate of cold working after annealing strongly is known. That is, in order to raise bending nature, it was a stock-in-trade that intensity reduces the rate of cold working low on the assumption that a bird clapper. That is, it was difficult to have made high intensity and the outstanding bending nature combine. this invention was made in view of the above-mentioned technical problem of the conventional material, and aims at obtaining a copper alloy board with the bending nature which was excellent while holding the high intensity of an Cu-nickel-Si system alloy.
[0004]
[Means for Solving the Problem] In order to solve the aforementioned technical problem, as a result of inquiring wholeheartedly about an Cu-nickel-Si system alloy board, by controlling the degree of integration of crystal orientation, this invention person finds out that bending nature can be improved, and came to make this invention. Namely, the copper alloy board concerning this invention contains Si:0.1 - 1wt% nickel:0.4 - 5wt%. When it consists of the remainder Cu and an unescapable impurity and X diffraction intensity from I {311} and {220} sides is further set [the X diffraction intensity from the {200} sides in a board front face] to I {220} for the X diffraction intensity from I {200} and {311} sides, it is characterized by filling the following formula.
[I{200}+I{311}]/I{220} >=0.5. [0005] In addition, the above-mentioned copper alloy board can contain Sn:0.01 - 5wt% either or both sides Zn:0.01 - 10wt%. The above-mentioned copper alloy board Furthermore, B, C, P, S, calcium, V, Ga, germanium, Each element [of Nb, Mo, Hf, Ta, Bi, and Pb] 0.0001 - 0.1wt% (when two or more sorts add, it is less than [0.1wt%] in total), one sort or two sorts or more of elements chosen from from while of each element [of Be, Mg, aluminum, Ti, Cr, Mn, Fe, Co, Zr, Ag, Cd, In, Sb, Te, and Au] 0.001 - 1wt% -- the sum total -- less than [1wt%] -- it can contain
[0006]
[Embodiments of the Invention] Next, the reasons for limitation of the component of the copper alloy concerning this invention, crystal orientation, etc. are explained.
(nickel and Si) These components are effective in raising intensity by forming the intermetallic compound of nickel and Si in the state where it lived together, without reducing conductivity sharply. If less than [0.4wt%] or/, and Si do not have [nickel] the effect less than [0.1wt%], and nickel exceeds 5wt(s)% or/and Si exceed 1wt%, hot-working nature will fall remarkably. Therefore, both components are made into Si:0.1 - 1wt% nickel:0.4 - 5wt%.

[0007] (Zn) Although Zn has the operation which raises solder heatproof detachability and migration-proof nature, less than [0.01wt%] is not enough as the effect. If 10wt(s)% is exceeded, while not only conductivity falls, but soldering nature will fall, stress corrosion crack sensitivity-proof becomes high and is not desirable, either. Therefore, Zn may be 0.01 - 10wt%.
(Sn) Sn is a component which raises intensity by solid solution strengthening. 0. If the effect exceeds 5wt% rather than is enough, while the effect will be saturated with less than [01wt%], between heat and cold-working nature deteriorate. Therefore, Sn may be 0.01 - 5wt%.
[0008] (Accessory constituent) Each element of B, C, P, S, calcium, V, Ga, germanium, Nb, Mo, Hf, Ta, Bi, and Pb has the role which raises press blanking nature. Less than [0.0001wt%], the effect does not exist, and if 0.1wt% is exceeded, while hot-working nature will deteriorate, as for these elements, bending nature also deteriorates. Moreover, each element of Be, Mg, aluminum, Ti, Cr, Mn, Fe, Co, Zr, Ag, Cd, In, Sb, Te, and Au has the role which raises press blanking nature, and, in addition, raises intensity further by coexistence with an nickel-Si compound. Less than [0.001wt%], the effect does not exist, and if 1wt% is exceeded, while between heat and cold-working nature will deteriorate, as for these elements, bending nature also deteriorates. Therefore, about above-mentioned Be-Au, it considers [B-Pb / above-mentioned] as each element 0.001 - 1wt% each element 0.0001 - 0.1wt% (in the case / Two or more sorts add. / the sum total 0.1wt(s)% less than), and it is both the sum total and may be less than / 1wt% /.
[0009] (Crystal orientation) {200} on the front face of a board and the accumulation rate of {311} sides increase, and if the copper alloy board containing nickel and Si is rolled out, its accumulation rate of {220} sides will increase, as it recrystallizes and the particle size becomes large. Although the copper alloy board concerning this invention is finished further hot rolling, cold rolling, solution treatment, cold rolling, deposit annealing, and if needed, and it is distorted and it is manufactured at cold rolling and the process of annealing, it can control this accumulation rate by adjusting the cold rolling process (working ratio) of solution treatment (solution-ized temperature, time) and after that in this manufacturing process. The accumulating-totals working ratio after the temperature to which solution treatment temperature specifically exceeds 710 degrees C, and solution treatment is the conditions that less than 50% is desirable. In addition, it deposit-anneals, or is distorted, and after that takes this accumulation rate, and it does not change a lot depending on annealing. Moreover, the content of nickel and Si also influences an accumulation rate. In this invention, these accumulation rates have bending nature and strong correlation, and the range of a proper accumulation rate is searched for as shown in the aforementioned formula based on knowledge that bending nature is controllable by controlling these accumulation rates on the front face of a board. In addition, if this value becomes not much large also with regards to the intensity of a board as for the value of [I{200}+I{311}]/I {220}, since the intensity of a board will fall, as for this value, 1.0 or less are desirable.
[0010]
[Example] Next, the example of this invention is explained below with the example of comparison. The air dissolution was carried out under charcoal covering in the kryptol furnace, the copper alloy of the chemical composition shown in Table 1 was cast to the book mold, and the 50x80x200mm ingot was produced. This ingot was heated at 930 degrees C, and after hot rolling, water quenching was carried out immediately and it considered as hot-rolling material with a thickness of 15mm. In order to remove the scale of the front face of this hot-rolling material, the front face was cut by the grinder. After cold-rolling this, solution treatment for 20 seconds and 30% of cold rolling were performed at 750 degrees C, it adjusted to 0.25mm of board thickness, deposit annealing of 2 hours was given at 480 degrees C, and the examination was presented.
[0011]
[Table 1]

		Cu	Ni	Si	Zn	Sn	副成分
発明例	1	残部	0.5	0.1	–	–	
	2	残部	1.0	0.2	–	–	
	3	残部	1.8	0.4	–	–	
	4	残部	3.2	0.7	–	–	
	5	残部	4.6	1.0	–	–	
	6	残部	1.8	0.4	1.1	–	
	7	残部	1.8	0.4	–	0.5	
	8	残部	1.8	0.4	1.1	0.5	
	9	残部	1.8	0.4	–	–	B:0.01, C:0.001, Be:0.02
	10	残部	1.8	0.4	–	–	P:0.005, Mg:0.04, Al:0.1
	11	残部	1.8	0.4	–	–	S:0.005, Ca:0.001, Ti:0.05
	12	残部	1.8	0.4	–	–	V:0.001, Cr:0.2, Mn:0.04
	13	残部	1.8	0.4	–	–	Ga:0.03, Ge:0.02, Fe:0.06
	14	残部	1.8	0.4	–	–	Nb:0.01, Co:0.1, Zr:0.07
	15	残部	1.8	0.4	–	–	Mo:0.003, Hf:0.008, Ag:0.1
	16	残部	1.8	0.4	–	–	Ta:0.004, Cd:0.1, In:0.2
	17	残部	1.8	0.4	–	–	Bi:0.0009, Pb:0.008 Sb:0.005
	18	残部	1.8	0.4	–	–	Te:0.01, Au:0.07
比較例	19	残部	0.3 *	0.07*	–	–	
	20	残部	5.2 *	1.2 *	–	–	
	21	残部	1.8	0.4	12 *	–	
	22	残部	1.8	0.4	–	5.8 *	
	23	残部	1.8	0.4	–	–	P:0.2* , Mn:0.02
	24	残部	1.8	0.4	–	–	Ca:0.002, Fe:1.6*

*本発明の規定範囲から外れる箇所

[0012] Moreover, in order to obtain the copper alloy board of various crystal orientation accumulation rates in addition to the above-mentioned process, about the alloy of composition of No.3, solution treatment temperature was manufactured to 750-degree C others on conditions (650 degrees C (No.3-5) and 700 degrees C (No.3-2)). Moreover, the rate of cold working after solution treatment was also manufactured to everything but 30% on 50% (No.3-3) and 60% (No.3-6) of conditions. Furthermore, the rate of finishing cold working after deposit annealing was also manufactured to everything [above] but 0% on 20% (No.3-4) and 50% (No.3-7) of conditions. About the material (No.3-4, No.3-7) which performed finish cold working after deposit annealing, it annealed by distorting 20 seconds at 450 degrees C. Any conditions adjusted the last board thickness to 0.25mm.
[0013] About these test specimens, tensile strength, proof stress, conductivity, W-bending processability, and crystal orientation were investigated in the following way. The result is shown in Table 2 and 3.
<Tensile strength, proof stress> JIS Z It applied to the method given in 2241 correspondingly. In addition, proof stress adopted 0.2% of permanent sets by the offset method. A test piece is JIS. Z The No. 5 test piece of 2201 was used.
<Conductivity> JIS H It applied to the method given in 0505 correspondingly. Measurement of electric resistance used the double bridge.
<W-bending> JIS H It applied to the method given in 3110 correspondingly. Test piece width of face was set to 10mm, and it bent, having applied the load of 1,000kgf. the ratio of minimum bend-radius R which makes the test piece extraction direction G.W. (a bending shaft is right-angled to a rolling direction), and B.W. (a bending shaft is parallel to a rolling direction), and a crack does not generate, and the test-specimen board thickness t -- R/t estimated

The copper alloy board front face of a <crystal orientation> final-product state (0.25mm thickness) was made to carry out incidence of the X-ray, and the intensity from each diffraction side was measured. Although the measurement depth from a front face changes with incident angles, the crystal orientation data in about 20-30-micrometer Fukashi are obtained at the maximum. Bending nature and correlation compared the rate of the diffraction intensity of {200}, {311}, and {220} sides from the inside, and it asked for the crystal orientation index ([I{200}+I {311}] /I {220}). [strong] In addition, the conditions of X-ray irradiation are kind:Cu of an X-ray. K-alpha 1, tube-voltage:40kV, the tube electric current: It was 200mA, and it measured, making a sample rotate within a flat surface.

[0014]

[Table 2]

	No.	引張強さ (N/mm²)	耐力 (N/mm²)	導電率 (%ISCA)	W曲げ性(R/t)		結晶方位指数 ※	備考
					G.W.	B.W		
発明例	1	500	450	53	0	0	0.93	
	2	550	500	52	0	0	0.86	
	3-1	640	580	50	0	0	0.75	
	3-2	610	550	51	0.5	0.5	0.59	(1)
	3-3	630	570	51	0.5	0.5	0.61	(2)
	3-4	660	630	49	1.0	1.0	0.54	(3)
	4	700	640	48	0.5	0.5	0.57	
	5	730	670	46	1.0	1.0	0.51	
	6	640	580	50	0	0	0.72	
	7	660	600	42	0	0	0.69	
	8	660	600	40	0	0	0.67	
	9	670	610	48	0	0	0.67	
	10	660	600	42	0	0	0.65	
	11	660	600	48	0	0	0.64	
	12	660	600	48	0	0	0.70	
	13	660	600	46	0	0	0.66	
	14	660	600	48	0	0	0.64	
	15	650	590	49	0	0	0.71	
	16	660	600	44	0	0	0.66	
	17	650	590	49	0	0	0.73	
	18	650	590	49	0	0	0.70	

※ [I {200} + I {311}] ／I {220}
(1)溶体化温度：700℃　(2)中間加工率：50%　(3)仕上げ加工率：20%

[0015]

[Table 3]

No.		引張強さ (N/mm²)	耐力 (N/mm²)	導電率 (%ISCA)	W曲げ性(R/t)		結晶方位指数 ※	備考
					G.W.	B.W.		
比較例	19	450 *	400 *	55	0	0	1.03	
	20	−	−	−	−	−	−	(1) *
	21	640	580	31 *	0	0	0.68	(2) *
	22	−	−	−	−	−	−	(1) *
	23	−	−	−	−	−	−	(1) *
	24	670	610	35 *	2.0 *	2.0 *	0.55	(3) *
	3-5	590	530	53	2.0 *	2.0 *	0.38 *	(4)
	3-6	610	550	51	2.0 *	2.0 *	0.44 *	(5)
	3-7	700	680	49	2.5 *	2.5 *	0.25 *	(6)

※ [I{200} + I{311}] ／I{220}
(1)熱間圧延大割れ (2)耐応力腐食割れ性低い (3)熱間圧延微小割れ
(4)溶体化温度：650℃ (5)中間加工率：60% (6)仕上げ加工率：50%
*特性の劣る箇所

[0016] Any property of No.1-18 of the example of this invention shown in Table 2 is good. Among these, No.1 and No.2 have nickel and lower Si and intensity is a little low. On the contrary, for a certain reason, nickel and Si raise 5 as No.4 and it comes out, and intensity is a little high, a crystal orientation index is lower and bending nature is a little low. Moreover, No.3-2, 3-3, and 3-4 have a lower crystal orientation index, and bending nature is a little low. On the other hand, for No.19 of the example of comparison shown in Table 3, nickel and Si are low and intensity is a low. On the contrary, since example No.of comparison 20 had nickel and high Si, the crack generated them with hot rolling. For example No.of comparison 21, since there is much Zn, conductivity is low, and stress-corrosion-cracking-proof nature is a low. Example No.of comparison 22 and No.23 had Sn or high P content, and the crack generated them with hot rolling. Bending nature is low, while No.24 have high Fe content and a microfissure occurs with hot rolling. No.3-5, 3-6, and 3-7 have a low crystal orientation index, and bending nature is low.

[0017]

[Effect of the Invention] According to this invention, the copper alloy board for electronic parts, such as a leadframe and a terminal with the outstanding bending nature, a connector, a switch, and a relay, can be obtained, maintaining high intensity.

[Translation done.]

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TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the copper alloy board excellent in suitable bending nature to use for electronic parts, such as a copper alloy board especially a leadframe, a terminal, a connector, a switch, and a relay.

[Translation done.]

* NOTICES *

PRIOR ART

[Description of the Prior Art] Various copper and the copper alloy are used for various electronic parts. In recent years, the flow of small-and-light-izing of electronic parts is progressing quickly. In connection with it, the outstanding bending nature which is equal to adhesion bending or 90-degree bending after notching is being required more often not to mention high intensity and high conductivity by the copper alloy board used for a leadframe, a terminal, a connector, a switch, a relay, etc. The Cu-nickel-Si system alloy is widely used for these uses especially as an alloy which has high intensity, high thermal resistance, a stress relaxation characteristic-proof [high], and comparatively high conductivity. However, coexistence of high intensity and bending nature was difficult for the present condition.

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EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, the copper alloy board for electronic parts, such as a leadframe and a terminal with the outstanding bending nature, a connector, a switch, and a relay, can be obtained, maintaining high intensity.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Conventionally, the elongation in a tension test has been used as the standard as an index of bending nature. Depending for the value of the elongation to the rate of cold working after annealing strongly is known. That is, in order to raise bending nature, it was a stock-in-trade that intensity reduces the rate of cold working low on the assumption that a bird clapper. That is, it was difficult to have made high intensity and the outstanding bending nature combine. this invention was made in view of the above-mentioned technical problem of the conventional material, and aims at obtaining a copper alloy board with the bending nature which was excellent while holding the high intensity of an Cu-nickel-Si system alloy.

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MEANS

[Means for Solving the Problem] In order to solve the aforementioned technical problem, as a result of inquiring wholeheartedly about an Cu-nickel-Si system alloy board, by controlling the degree of integration of crystal orientation, this invention person finds out that bending nature can be improved, and came to make this invention. Namely, the copper alloy board concerning this invention contains Si:0.1 - 1wt% nickel:0.4 - 5wt%. When it consists of the remainder Cu and an unescapable impurity and X diffraction intensity from I {311} and {220} sides is further set [the X diffraction intensity from the {200} sides in a board front face] to I {220} for the X diffraction intensity from I {200} and {311} sides, it is characterized by filling the following formula. [I{200}+I{311}]/I{220} >=0.5. [0005] In addition, the above-mentioned copper alloy board can contain Sn:0.01 - 5wt% either or both sides Zn:0.01 - 10wt%. The above-mentioned copper alloy board Furthermore, B, C, P, S, calcium, V, Ga, germanium, Each element [of Nb, Mo, Hf, Ta, Bi, and Pb] 0.0001 - 0.1wt% (when two or more sorts add, it is less than [0.1wt%] in total), one sort or two sorts or more of elements chosen from from while of each element [of Be, Mg, aluminum, Ti, Cr, Mn, Fe, Co, Zr, Ag, Cd, In, Sb, Te, and Au] 0.001 - 1wt% -- the sum total -- less than [1wt%] -- it can contain
[0006]
[Embodiments of the Invention] Next, the reasons for limitation of the component of the copper alloy concerning this invention, crystal orientation, etc. are explained.
(nickel and Si) These components are effective in raising intensity by forming the intermetallic compound of nickel and Si in the state where it lived together, without reducing conductivity sharply. If less than [0.4wt%] or/, and Si do not have [nickel] the effect less than [0.1wt%], and nickel exceeds 5wt(s)% or/and Si exceed 1wt%, hot-working nature will fall remarkably. Therefore, both components are made into Si:0.1 - 1wt% nickel:0.4 - 5wt%.
[0007] (Zn) Although Zn has the operation which raises solder heatproof detachability and migration-proof nature, less than [0.01wt%] is not enough as the effect. If 10wt(s)% is exceeded, while not only conductivity falls, but soldering nature will fall, stress corrosion crack sensitivity-proof becomes high and is not desirable, either. Therefore, Zn may be 0.01 - 10wt%.
(Sn) Sn is a component which raises intensity by solid solution strengthening. 0. If the effect exceeds 5wt% rather than is enough, while the effect will be saturated with less than [01wt%], between heat and cold-working nature deteriorate. Therefore, Sn may be 0.01 - 5wt%.
[0008] (Accessory constituent) Each element of B, C, P, S, calcium, V, Ga, germanium, Nb, Mo, Hf, Ta, Bi, and Pb has the role which raises press blanking nature. Less than [0.0001wt%], the effect does not exist, and if 0.1wt% is exceeded, while hot-working nature will deteriorate, as for these elements, bending nature also deteriorates. Moreover, each element of Be, Mg, aluminum, Ti, Cr, Mn, Fe, Co, Zr, Ag, Cd, In, Sb, Te, and Au has the role which raises press blanking nature, and, in addition, raises intensity further by coexistence with an nickel-Si compound. Less than [0.001wt%], the effect does not exist, and if 1wt% is exceeded, while between heat and cold-working nature will deteriorate, as for these elements, bending nature also deteriorates. Therefore, about above-mentioned Be-Au, it considers [B-Pb / above-mentioned] as each element 0.001 - 1wt% each element 0.0001 - 0.1wt% (in the case / Two or more sorts add. / the sum total 0.1wt(s)% less than), and it is both the sum total and may be less than / 1wt% /.
[0009] (Crystal orientation) {200} on the front face of a board and the accumulation rate of {311} sides increase, and if the copper alloy board containing nickel and Si is rolled out, its accumulation rate of {220} sides will increase, as it recrystallizes and the particle size becomes large. Although the copper alloy board concerning this invention is finished further hot rolling, cold rolling, solution treatment, cold rolling, deposit annealing, and if needed, and it is distorted and it is manufactured at cold rolling and the process of annealing, it can control this accumulation rate by adjusting the cold rolling process (working ratio) of solution treatment (solution-ized

temperature, time) and after that in this manufacturing process. The accumulating-totals working ratio after the temperature to which solution treatment temperature specifically exceeds 710 degrees C, and solution treatment is the conditions that less than 50% is desirable. In addition, it deposit-anneals, or is distorted, and after that takes this accumulation rate, and it does not change a lot depending on annealing. Moreover, the content of nickel and Si also influences an accumulation rate. In this invention, these accumulation rates have bending nature and strong correlation, and the range of a proper accumulation rate is searched for as shown in the aforementioned formula based on knowledge that bending nature is controllable by controlling these accumulation rates on the front face of a board. In addition, if this value becomes not much large also with regards to the intensity of a board as for the value of [I{200}+I{311}]/I {220}, since the intensity of a board will fall, as for this value, 1.0 or less are desirable.

[Translation done.]

EXAMPLE

[Example] Next, the example of this invention is explained below with the example of comparison. The air dissolution was carried out under charcoal covering in the kryptol furnace, the copper alloy of the chemical composition shown in Table 1 was cast to the book mold, and the 50x80x200mm ingot was produced. This ingot was heated at 930 degrees C, and after hot rolling, water quenching was carried out immediately and it considered as hot-rolling material with a thickness of 15mm. In order to remove the scale of the front face of this hot-rolling material, the front face was cut by the grinder. After cold-rolling this, solution treatment for 20 seconds and 30% of cold rolling were performed at 750 degrees C, it adjusted to 0.25mm of board thickness, deposit annealing of 2 hours was given at 480 degrees C, and the examination was presented.
[0011]
[Table 1]

		Cu	Ni	Si	Zn	Sn	副成分
発明例	1	残部	0.5	0.1	–	–	
	2	残部	1.0	0.2	–	–	
	3	残部	1.8	0.4	–	–	
	4	残部	3.2	0.7	–	–	
	5	残部	4.6	1.0	–	–	
	6	残部	1.8	0.4	1.1	–	
	7	残部	1.8	0.4	–	0.5	
	8	残部	1.8	0.4	1.1	0.5	
	9	残部	1.8	0.4	–	–	B:0.01, C:0.001, Be:0.02
	10	残部	1.8	0.4	–	–	P:0.005, Mg:0.04, Al:0.1
	11	残部	1.8	0.4	–	–	S:0.005, Ca:0.001, Ti:0.05
	12	残部	1.8	0.4	–	–	V:0.001, Cr:0.2, Mn:0.04
	13	残部	1.8	0.4	–	–	Ga:0.03, Ge:0.02, Fe:0.06
	14	残部	1.8	0.4	–	–	Nb:0.01, Co:0.1, Zr:0.07
	15	残部	1.8	0.4	–	–	Mo:0.003, Hf:0.008, Ag:0.1
	16	残部	1.8	0.4	–	–	Ta:0.004, Cd:0.1, In:0.2
	17	残部	1.8	0.4	–	–	Bi:0.0009, Pb:0.008 Sb:0.005
	18	残部	1.8	0.4	–	–	Te:0.01, Au:0.07
比較例	19	残部	0.3 *	0.07*	–	–	
	20	残部	5.2 *	1.2 *	–	–	
	21	残部	1.8	0.4	12 *	–	
	22	残部	1.8	0.4	–	5.8 *	
	23	残部	1.8	0.4	–	–	P:0.2* , Mn:0.02
	24	残部	1.8	0.4	–	–	Ca:0.002, Fe:1.6*

*本発明の規定範囲から外れる箇所

[0012] Moreover, in order to obtain the copper alloy board of various crystal orientation accumulation rates in addition to the above-mentioned process, about the alloy of composition of No.3, solution treatment temperature was manufactured to 750-degree C others on conditions (650 degrees C (No.3-5) and 700 degrees C (No.3-2)). Moreover, the rate of cold working after solution treatment was also manufactured to everything but 30% on 50% (No.3-3) and 60% (No.3-6) of conditions. Furthermore, the rate of finishing cold working after deposit annealing was also manufactured to everything [above] but 0% on 20% (No.3-4) and 50% (No.3-7) of conditions. About the material (No.3-4, No.3-7) which performed finish cold working after deposit annealing, it annealed by distorting 20 seconds at 450 degrees C. Any conditions adjusted the last board thickness to 0.25mm.
[0013] About these test specimens, tensile strength, proof stress, conductivity, W-bending processability, and crystal orientation were investigated in the following way. The result is shown in Table 2 and 3.
<Tensile strength, proof stress> JIS Z It applied to the method given in 2241 correspondingly. In addition, proof stress adopted 0.2% of permanent sets by the offset method. A test piece is JIS. Z The No. 5 test piece of 2201 was used.
<Conductivity> JIS H It applied to the method given in 0505 correspondingly. Measurement of electric resistance used the double bridge.
<W-bending> JIS H It applied to the method given in 3110 correspondingly. Test piece width of face was set to 10mm, and it bent, having applied the load of 1,000kgf. the ratio of minimum bend-radius R which makes the test piece extraction direction G.W. (a bending shaft is right-angled to a rolling direction), and B.W. (a bending shaft is parallel to a rolling direction), and a crack does not generate, and the test-specimen board thickness t -- R/t estimated

The copper alloy board front face of a <crystal orientation> final-product state (0.25mm thickness) was made to carry out incidence of the X-ray, and the intensity from each diffraction side was measured. Although the measurement depth from a front face changes with incident angles, the crystal orientation data in about 20-30-micrometer Fukashi are obtained at the maximum. Bending nature and correlation compared the rate of the diffraction intensity of {200}, {311}, and {220} sides from the inside, and it asked for the crystal orientation index ([I{200}+I {311}] /I {220}). [strong] In addition, the conditions of X-ray irradiation are kind:Cu of an X-ray. K-alpha 1, tube-voltage:40kV, the tube electric current: It was 200mA, and it measured, making a sample rotate within a flat surface.

[0014]

[Table 2]

	No.	引張強さ (N/mm²)	耐力 (N/mm²)	導電率 (%ISCA)	W曲げ性(R/t)		結晶方位指数 ※	備考
					G.W.	B.W		
発明例	1	500	450	53	0	0	0.93	
	2	550	500	52	0	0	0.86	
	3-1	640	580	50	0	0	0.75	
	3-2	610	550	51	0.5	0.5	0.59	(1)
	3-3	630	570	51	0.5	0.5	0.61	(2)
	3-4	660	630	49	1.0	1.0	0.54	(3)
	4	700	640	48	0.5	0.5	0.57	
	5	730	670	46	1.0	1.0	0.51	
	6	640	580	50	0	0	0.72	
	7	660	600	42	0	0	0.69	
	8	660	600	40	0	0	0.67	
	9	670	610	48	0	0	0.67	
	10	660	600	42	0	0	0.65	
	11	660	600	48	0	0	0.64	
	12	660	600	48	0	0	0.70	
	13	660	600	46	0	0	0.66	
	14	660	600	48	0	0	0.64	
	15	650	590	49	0	0	0.71	
	16	660	600	44	0	0	0.66	
	17	650	590	49	0	0	0.73	
	18	650	590	49	0	0	0.70	

※ [I {200} + I {311}] ／I {220}
(1)溶体化温度：700℃　(2)中間加工率：50%　(3)仕上げ加工率：20%

[0015]

[Table 3]

	No.	引張強さ (N/mm²)	耐力 (N/mm²)	導電率 (%ISCA)	W曲げ性(R/t) G.W.	W曲げ性(R/t) B.W.	結晶方位指数 ※	備考
比較例	19	450 *	400 *	55	0	0	1.03	
	20	—	—	—	—	—	—	(1) *
	21	640	580	31 *	0	0	0.68	(2) *
	22	—	—	—	—	—	—	(1) *
	23	—	—	—	—	—	—	(1) *
	24	670	610	35 *	2.0 *	2.0 *	0.55	(3) *
	3-5	590	530	53	2.0 *	2.0 *	0.38 *	(4)
	3-6	610	550	51	2.0 *	2.0 *	0.44 *	(5)
	3-7	700	680	49	2.5 *	2.5 *	0.25 *	(6)

※ [I{200}＋I{311}]／I{220}
(1)熱間圧延大割れ (2)耐応力腐食割れ性低い (3)熱間圧延微小割れ
(4)溶体化温度：650℃ (5)中間加工率：60% (6)仕上げ加工率：50%
*特性の劣る箇所

[0016] Any property of No.1-18 of the example of this invention shown in Table 2 is good. Among these, No.1 and No.2 have nickel and lower Si and intensity is a little low. On the contrary, for a certain reason, nickel and Si raise 5 as No.4 and it comes out, and intensity is a little high, a crystal orientation index is lower and bending nature is a little low. Moreover, No.3-2, 3-3, and 3-4 have a lower crystal orientation index, and bending nature is a little low. On the other hand, for No.19 of the example of comparison shown in Table 3, nickel and Si are low and intensity is a low. On the contrary, since example No.of comparison 20 had nickel and high Si, the crack generated them with hot rolling. For example No.of comparison 21, since there is much Zn, conductivity is low, and stress-corrosion-cracking-proof nature is a low. Example No.of comparison 22 and No.23 had Sn or high P content, and the crack generated them with hot rolling. Bending nature is low, while No.24 have high Fe content and a microfissure occurs with hot rolling. No.3-5, 3-6, and 3-7 have a low crystal orientation index, and bending nature is low.

[Translation done.]

D14

COPPER ALLOY SHEET EXCELLENT IN BENDABILITY

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Applicant(s): KOBE STEEL LTD

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Abstract

PROBLEM TO BE SOLVED: To obtain a copper alloy sheet having excellent bendability while keeping the high strength of a Cu-Ni-Si alloy.

SOLUTION: This copper alloy sheet has a composition consisting of, by weight, 0.4-5% Ni, 0.1-1% Si, and the balance Cu with inevitable impurities and containing, if necessary, either or both of 0.01-10% Zn and 0.01-5% Sn. Further, when I 200}, I 311}, and I 220} represent the X-ray diffraction intensities from the 200} plane, 311} plane, and 220) plane at the sheet surface, respectively, inequality [I 200}+I 311}]/I 220}>=0.5 is satisfied.

TOP

D14

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(54)【発明の名称】　曲げ加工性が優れた銅合金板

(57)【要約】
【目的】　Ｃｕ－Ｎｉ－Ｓｉ系合金の高強度を保持しながら、優れた曲げ加工性を持つ銅合金板を得る。
【構成】　Ｎｉ：０．４～５ｗｔ％、Ｓｉ：０．１～１ｗｔ％を含み、必要に応じてＺｎ：０．０１～１０ｗｔ％、Ｓｎ：０．０１～５ｗｔ％のいずれか一方又は双方を含み、残部Ｃｕと不可避不純物からなり、さらに板表面における｛２００｝面からのX線回折強度をＩ{200}、｛３１１｝面からのX線回折強度をＩ{311}、｛２２０｝面からのX線回折強度をＩ{220}としたとき、下記式を満たすことを特徴とする曲げ加工性が優れた銅合金板。
$[I\{200\}+I\{311\}]/I\{220\} \geq 0.5$

【特許請求の範囲】

【請求項1】 Ni：0．4〜5wt%、Si：0．1〜1wt%を含み、残部Cuと不可避不純物からなり、さらに板表面における｛200｝面からのX線回折強度をI{200}、｛311｝面からのX線回折強度をI{311}、｛220｝面からのX線回折強度をI{220}としたとき、下記式を満たすことを特徴とする曲げ加工性が優れた銅合金板。

［I{200}＋I{311}］／I{220}≧0．5

【請求項2】 Ni：0．4〜5wt%、Si：0．1〜1wt%、Zn：0．01〜10wt%を含み、残部Cuと不可避不純物からなり、さらに板表面における｛200｝面からのX線回折強度をI{200}、｛311｝面からのX線回折強度をI{311}、｛220｝面からのX線回折強度をI{220}としたとき、下記式を満たすことを特徴とする曲げ加工性が優れた銅合金板。

［I{200}＋I{311}］／I{220}≧0．5

【請求項3】 Ni：0．4〜5wt%、Si：0．1〜1wt%、Sn：0．01〜5wt%を含み、残部Cuと不可避不純物からなり、さらに板表面における｛200｝面からのX線回折強度をI{200}、｛311｝面からのX線回折強度をI{311}、｛220｝面からのX線回折強度をI{220}としたとき、下記式を満たすことを特徴とする曲げ加工性が優れた銅合金板。

［I{200}＋I{311}］／I{220}≧0．5

【請求項4】 Ni：0．4〜5wt%、Si：0．1〜1wt%、Zn：0．01〜10wt%、Sn：0．01〜5wt%を含み、残部Cuと不可避不純物からなり、さらに板表面における｛200｝面からのX線回折強度をI{200}、｛311｝面からのX線回折強度をI{311}、｛220｝面からのX線回折強度をI{220}としたとき、下記式を満たすことを特徴とする曲げ加工性が優れた銅合金板。

［I{200}＋I{311}］／I{220}≧0．5

【請求項5】 B、C、P、S、Ca、V、Ga、Ge、Nb、Mo、Hf、Ta、Bi、Pbの各元素0．0001〜0．1wt%、Be、Mg、Al、Ti、Cr、Mn、Fe、Co、Zr、Ag、Cd、In、Sb、Te、Auの各元素0．001〜1wt%のうちから選ばれた、1種又は2種以上の元素を合計で1wt%以下含有することを特徴とする請求項1〜4のいずれかに記載された曲げ加工性が優れた銅合金板。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は銅合金板、とくにリードフレーム、端子、コネクタ、スイッチ、リレーなどの電子部品に用いるに好適な曲げ加工性が優れた銅合金板に関するものである。

【0002】

【従来の技術】各種電子部品に、各種銅及び銅合金が用いられている。近年、電子部品の軽薄短小化の流れが急速に進展している。それに伴い、リードフレーム、端子、コネクタ、スイッチ、リレーなどに用いられる銅合金板は、高強度、高導電率はもちろんのこと、密着曲げあるいはノッチング後90°曲げなどに耐える優れた曲げ加工性が要求されることが多くなってきている。なかでもCu−Ni−Si系合金は、高強度、高耐熱性、高い耐応力緩和特性及び比較的高い導電率を兼備する合金としてこれらの用途に広く用いられている。しかし、高強度と曲げ加工性の両立は難しいのが現状であった。

【0003】

【発明が解決しようとする課題】従来、曲げ加工性の指標として引張試験における伸びがその目安として用いられてきた。その伸びの値は焼鈍後の冷間加工率に強く依存することが知られている。すなわち、曲げ加工性を向上させるためには、強度が低くなることを前提に冷間加工率を低減させるというのが常套手段であった。つまり、高い強度と優れた曲げ加工性を兼備させることは困難であった。本発明は従来の材料の上記課題に鑑みてなされたもので、Cu−Ni−Si系合金の高い強度を保持しながら優れた曲げ加工性を持つ銅合金板を得ることを目的とする。

【0004】

【課題を解決するための手段】本発明者は、前記課題を解決するためにCu−Ni−Si系合金板について鋭意研究した結果、結晶方位の集積度を制御することにより曲げ加工性を向上できることを見い出し、本発明をなすに至った。すなわち、本発明に係る銅合金板は、Ni：0．4〜5wt%、Si：0．1〜1wt%を含み、残部Cuと不可避不純物からなり、さらに板表面における｛200｝面からのX線回折強度をI{200}、｛311｝面からのX線回折強度をI｛311｝、｛220｝面からのX線回折強度をI｛220｝としたとき、下記式を満たすことを特徴とする。

［I{200}＋I{311}］／I{220}≧0．5

【0005】なお、上記の銅合金板は、Zn：0．01〜10wt%、Sn：0．01〜5wt%のいずれか一方又は双方を含有することができる。さらに、上記の銅合金板は、B、C、P、S、Ca、V、Ga、Ge、Nb、Mo、Hf、Ta、Bi、Pbの各元素0．0001〜0．1wt%（2種以上添加する場合は合計で0．1wt%以下）、Be、Mg、Al、Ti、Cr、Mn、Fe、Co、Zr、Ag、Cd、In、Sb、Te、Auの各元素0．001〜1wt%のうちから選ばれた、1種又は2種以上の元素を合計で1wt%以下含有することができる。

【0006】

【発明の実施の形態】次に、本発明に係る銅合金の成分及び結晶方位等の限定理由について説明する。

（Ni及びSi）これらの成分は、共存した状態でNi

とＳｉの金属間化合物を形成することにより、導電率を大幅に低下させることなく強度を向上させる効果がある。Ｎｉが０．４ｗｔ％未満又は／及びＳｉが０．１ｗｔ％未満ではその効果がなく、Ｎｉが５ｗｔ％を超え又は／及びＳｉが１ｗｔ％を超えると熱間加工性が著しく低下する。従って、両成分はＮｉ：０．４～５ｗｔ％、Ｓｉ：０．１～１ｗｔ％とする。

【０００７】（Ｚｎ）Ｚｎは、はんだ耐熱剥離性及び耐マイグレーション性を向上させる作用があるが、０．０１ｗｔ％未満ではその効果が十分ではない。１０ｗｔ％を超えると導電率が低下するだけでなく、はんだ付け性が低下するとともに、耐応力腐食割れ感受性も高くなり好ましくない。従って、Ｚｎは０．０１～１０ｗｔ％とする。

（Ｓｎ）Ｓｎは、固溶強化により強度を向上させる成分である。０．０１ｗｔ％未満ではその効果が十分ではなく、５ｗｔ％を超えるとその効果が飽和するとともに、熱間および冷間加工性が劣化する。従って、Ｓｎは０．０１～５ｗｔ％とする。

【０００８】（副成分）Ｂ、Ｃ、Ｐ、Ｓ、Ｃａ、Ｖ、Ｇａ、Ｇｅ、Ｎｂ、Ｍｏ、Ｈｆ、Ｔａ、Ｂｉ、Ｐｂの各元素はプレス打抜き性を向上させる役割を有する。これらの元素は、０．０００１ｗｔ％未満ではその効果がなく、０．１ｗｔ％を超えると熱間加工性が劣化するとともに曲げ加工性も劣化する。また、Ｂｅ、Ｍｇ、Ａｌ、Ｔｉ、Ｃｒ、Ｍｎ、Ｆｅ、Ｃｏ、Ｚｒ、Ａｇ、Ｃｄ、Ｉｎ、Ｓｂ、Ｔｅ、Ａｕの各元素は、プレス打抜き性を向上させる役割を有し、加えてＮｉ－Ｓｉ化合物との共存により強度を一層向上させる。これらの元素は、０．００１ｗｔ％未満ではその効果がなく、１ｗｔ％を超えると熱間及び冷間加工性が劣化するとともに曲げ加工性も劣化する。従って、、上記Ｂ～Ｐｂについては各元素０．０００１～０．１ｗｔ％（２種以上添加する場合は合計で０．１ｗｔ％以下）、上記Ｂｅ～Ａｕについては各元素０．００１～１ｗｔ％とし、両方合計で１ｗｔ％以下とする。

【０００９】（結晶方位）ＮｉとＳｉを含有する銅合金板は、再結晶しその粒径が大きくなるに従って板表面への｛２００｝、｛３１１｝面の集積割合が増し、圧延すると｛２２０｝面の集積割合が増してくる。本発明に係る銅合金板は、例えば熱間圧延、冷間圧延、溶体化処理、冷間圧延、析出焼鈍、必要に応じてさらに仕上げ冷間圧延及び歪み取り焼鈍という工程で製造されるが、この製造工程において、例えば溶体化処理（溶体化温度、時間）とその後の冷間圧延工程（加工率）を調整することで、この集積割合を制御することができる。具体的には溶体化処理温度は７１０℃を超える温度、溶体化処理後の累計加工率は５０％未満が好ましい条件である。なお、この集積割合はその後の析出焼鈍あるいは歪み取り焼鈍によっては大きく変化しない。また、ＮｉとＳｉの含有量も集積割合に影響する。本発明では、これらの集積割合が曲げ加工性と強い相関を持ち、板表面へのこれらの集積割合を制御することにより曲げ加工性を制御できるとの知見をもとに、前記式に示すとおり、適正な集積割合の範囲を求めたものである。なお、［Ｉ{200}＋Ｉ{311}］／Ｉ{220}の値は板の強度にも関係し、この値が余り大きくなると板の強度が低下することから、この値は１．０以下が望ましい。

【００１０】

【実施例】次に、本発明の実施例について、比較例とともに以下に説明する。表１に示す化学組成の銅合金を、クリプトル炉にて木炭被覆下で大気溶解し、ブックモールドに鋳造し、５０×８０×２００ｍｍの鋳塊を作製した。この鋳塊を９３０℃に加熱し熱間圧延後、直ちに水中急冷し厚さ１５ｍｍの熱延材とした。この熱延材の表面の酸化スケールを除去するため、表面をグラインダで切削した。これを冷間圧延した後、７５０℃で２０秒の溶体化処理、３０％の冷間圧延を施して板厚０．２５ｍｍに調整し、４８０℃で２時間の析出焼鈍を施し、試験に供した。

【００１１】

【表１】

		Cu	Ni	Si	Zn	Sn	副成分
発明例	1	残部	0.5	0.1	−	−	
	2	残部	1.0	0.2	−	−	
	3	残部	1.8	0.4	−	−	
	4	残部	3.2	0.7	−	−	
	5	残部	4.6	1.0	−	−	
	6	残部	1.8	0.4	1.1	−	
	7	残部	1.8	0.4	−	0.5	
	8	残部	1.8	0.4	1.1	0.5	
	9	残部	1.8	0.4	−	−	B:0.01, C:0.001, Be:0.02
	10	残部	1.8	0.4	−	−	P:0.005, Mg:0.04, Al:0.1
	11	残部	1.8	0.4	−	−	S:0.005, Ca:0.001, Ti:0.05
	12	残部	1.8	0.4	−	−	V:0.001, Cr:0.2, Mn:0.04
	13	残部	1.8	0.4	−	−	Ga:0.03, Ge:0.02, Fe:0.06
	14	残部	1.8	0.4	−	−	Nb:0.01, Co:0.1, Zr:0.07
	15	残部	1.8	0.4	−	−	Mo:0.003, Hf:0.008, Ag:0.1
	16	残部	1.8	0.4	−	−	Ta:0.004, Cd:0.1, In:0.2
	17	残部	1.8	0.4	−	−	Bi:0.0009, Pb:0.008 Sb:0.005
	18	残部	1.8	0.4	−	−	Te:0.01, Au:0.07
比較例	19	残部	0.3 *	0.07*	−	−	
	20	残部	5.2 *	1.2 *	−	−	
	21	残部	1.8	0.4	12 *	−	
	22	残部	1.8	0.4	−	5.8 *	
	23	残部	1.8	0.4	−	−	P:0.2* , Mn:0.02
	24	残部	1.8	0.4	−	−	Ca:0.002, Fe:1.6*

*本発明の規定範囲から外れる箇所

【0012】また、上記工程以外に、種々の結晶方位集積割合の銅合金板を得るため、No．3の組成の合金については、溶体化処理温度を750℃の他に650℃（No．3-5）、700℃（No．3-2）の条件にて製作した。また溶体化処理後の冷間加工率も30％の他に50％（No．3-3）、60％（No．3-6）の条件にて製作した。さらに、析出焼鈍後の仕上げ冷間加工率も前記の0％の他に20％（No．3-4）、50％（No．3-7）の条件にて製作した。析出焼鈍後に仕上冷間加工を施した材料（No．3-4、No．3-7）については450℃で20秒の歪み取り焼鈍を施した。いずれの条件によっても、最終板厚は0．25mmに調整した。

【0013】これらの供試材について、引張強さ、耐力、導電率、W曲げ加工性及び結晶方位を下記要領にて調査した。その結果を表2及び表3に示す。

<引張強さ、耐力>ＪＩＳ　Ｚ　２２４１に記載の方法に準じた。なお、耐力はオフセット法で永久伸び０．２％を採用した。試験片は、ＪＩＳ　Ｚ　２２０１の５号試験片を用いた。

<導電率>ＪＩＳ　Ｈ　０５０５に記載の方法に準じた。電気抵抗の測定はダブルブリッジを用いた。

<W曲げ>ＪＩＳ　Ｈ　３１１０に記載の方法に準じた。試験片幅を10mmとし、1，000kgfの荷重をかけて曲げた。試験片採取方向は、G．W．（曲げ軸が圧延方向に直角）及びB．W．（曲げ軸が圧延方向に平行）とし、割れの発生しない最小曲げ半径Rと供試材板厚tの比R／tにて評価した。

<結晶方位>最終製品状態（０．２５mm厚さ）の銅合金板表面にX線を入射させ、各回折面からの強度を測定した。表面からの測定深さは入射角によって変化するが、最大で約20〜30μmの深さまでの結晶方位データが得られる。その中から曲げ加工性と相関が強い｛200｝、｛311｝及び｛220｝面の回折強度の割合を比較し、結晶方位指数（［I{200}＋I{311}］／I{220}）を求めた。なお、X線照射の条件は、X線の種類：Cu　K−α1、管電圧：40kV、管電流：20

0mAであり、試料を平面内で自転させながら測定した。

【0014】

【表2】

	No.	引張強さ (N/mm²)	耐力 (N/mm²)	導電率 (%ISCA)	W曲げ性(R/t) G.W.	W曲げ性(R/t) B.W	結晶方位指数 ※	備考
発明例	1	500	450	53	0	0	0.93	
	2	550	500	52	0	0	0.86	
	3-1	640	580	50	0	0	0.75	
	3-2	610	550	51	0.5	0.5	0.59	(1)
	3-3	630	570	51	0.5	0.5	0.61	(2)
	3-4	660	630	49	1.0	1.0	0.54	(3)
	4	700	640	48	0.5	0.5	0.57	
	5	730	670	46	1.0	1.0	0.51	
	6	640	580	50	0	0	0.72	
	7	660	600	42	0	0	0.69	
	8	660	600	40	0	0	0.67	
	9	670	610	48	0	0	0.67	
	10	660	600	42	0	0	0.65	
	11	660	600	48	0	0	0.64	
	12	660	600	48	0	0	0.70	
	13	660	600	46	0	0	0.66	
	14	660	600	48	0	0	0.64	
	15	650	590	49	0	0	0.71	
	16	660	600	44	0	0	0.66	
	17	650	590	49	0	0	0.73	
	18	650	590	49	0	0	0.70	

※［I{200}+I{311}］／I{220}
(1)溶体化温度：700℃　(2)中間加工率：50%　(3)仕上げ加工率：20%

【0015】

【表3】

	No.	引張強さ (N/mm²)	耐力 (N/mm²)	導電率 (%ISCA)	W曲げ性(R/t) G.W.	W曲げ性(R/t) B.W.	結晶方位指数 ※	備考
比較例	19	450 *	400 *	55	0	0	1.03	
	20	−	−	−	−	−	−	(1) *
	21	640	580	31 *	0	0	0.68	(2) *
	22	−	−	−	−	−	−	(1) *
	23	−	−	−	−	−	−	(1) *
	24	670	610	35 *	2.0 *	2.0 *	0.55	(3) *
	3-5	590	530	53	2.0 *	2.0 *	0.38 *	(4)
	3-6	610	550	51	2.0 *	2.0 *	0.44 *	(5)
	3-7	700	680	49	2.5 *	2.5 *	0.25 *	(6)

※［I{200}+I{311}］／I{220}
(1)熱間圧延大割れ　(2)耐応力腐食割れ性低い　(3)熱間圧延微小割れ
(4)溶体化温度：650℃　(5)中間加工率：60%　(6)仕上げ加工率：50%
*特性の劣る箇所

【0016】表2に示す本発明例のNo．1～18はいずれの特性も良好である。このうち、No．1とNo．

2はＮｉとＳｉが低めであり、強度がやや低くなっている。逆に、Ｎｏ．４と5はＮｉとＳｉが高めであるため、強度がやや高く、結晶方位指数が低めで、曲げ加工性がやや低くなっている。またＮｏ．3-2、3-3、3-4は結晶方位指数が低めであり、曲げ加工性がやや低くなっている。一方、表3に示す比較例のＮｏ．１９はＮｉとＳｉが低く、強度が低い。逆に、比較例Ｎｏ．２０はＮｉとＳｉが高いため、熱間圧延で割れが発生した。比較例Ｎｏ．２１はＺｎが多いため、導電率が低く、耐応力腐食割れ性が低い。比較例Ｎｏ．２２、Ｎｏ．２３はＳｎ又はＰ含有量が高く、熱間圧延で割れが発生した。Ｎｏ．２４はＦｅ含有量が高く、熱間圧延で微小割れが発生するとともに、曲げ加工性が低くなっている。Ｎｏ．3-5、3-6、3-7は、結晶方位指数が低く、曲げ加工性が低くなっている。

【0017】

【発明の効果】本発明によれば、高強度を維持しながら、優れた曲げ加工性を持つリードフレーム、端子、コネクタ、スイッチ、リレーなどの電子部品用の銅合金板を得ることができる。

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	６８３	６８３	
	６８４	６８４Ａ	
	６８５	６８５Ｚ	
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